Oklahoma State University
Research Foundation

Annual Report
NASA Grant NsG-609
1 April 1965 to 31 March 1966

Project: Surface Parameters of Solids

Personnel:

Co-Investigators: Dr. E. E. Kohnke, Department of Physics
Dr. C. M. Cunningham, Department of Chemistry

Under the direction of the Co-Investigators listed above, five students are now actively engaged in dissertation research on problems falling within the scope of this project. Two are NASA Trainees, one is an NDEA Fellow who returned to the campus from Navy duty this September to enter the third year of his Fellowship, and two others presently hold the budgeted Graduate Research Assistant positions:

H. Matthews - Prospective Ph.D. Candidate, NASA Trainee

J. Rutledge - Prospective Ph.D. Candidate, NASA Trainee

R. Eagleton - Prospective Ph.D. Candidate, NDEA Fellow

J. Tunheim - Prospective Ph.D. Candidate

T. Vernardakis - M.S. Candidate

Post-Doctoral Research Associate (June-August 1965)

Dr. J. Houston

Degrees Granted:

During the current year two degrees have been awarded to persons who have received some measure of support from project funds:

J. Houston - Ph.D. (Physics), May, 1965

H. Matthews (NASA Trainee) - M.S. (Physics), May, 1965

In addition, Mr. J. Rutledge (NASA Trainee) has completed the formal requirements

for the degree of Master of Science (Physics) although it will not be officially awarded until May, 1966, commencement.

Reports and Publications:

Two official reports have been prepared for the NASA Office of Grants and Research Contracts during the current project year:

Interim Report SS-1: (Published as a NASA Contractor Report, NASA CR-376)

"A Preliminary Study of Certain Electrical Properties of Stannic Oxide Ceramics," H. E. Matthews and E. E. Kohnke (April 1965).

Interim Report SS-2: (To be published by NASA)

"Surface Parameters of Stannic Oxide in Powder, Ceramic, and Gel Form by Nitrogen Adsorption Techniques," J. L. Rutledge, E. E. Kohnke and C. M. Cunningham, (December 1965).

To provide experience for the students involved, short papers were presented on these topics at the 1964 and 1965 Oklahoma Academy of Sciences meetings respectively. Reprints of the first "The Dispersion of Dielectric Constant and Resistivity in Stannic Oxide Ceramics" Herman E. Matthews, Jr., Proc. Okla. Acad. Sci. 45, 138 (1965), have been forwarded to the NASA Office of Grants and Research Contracts. Reprints of the second will be provided when they become available.

Of some interest, although the work was not supported by NASA, are two publications on stannic oxide single crystals. These delineate some of the experimental and theoretical considerations that are being applied to ceramic specimens under the present grant:

"Photoelectronic Analysis of Imperfections in Grown Stannic Oxide Single Crystals", Jack E. Houston and E. E. Kohnke, J. Appl. Phys. 36, 3931 (1965).

"Optical Quenching of Photoconductivity in Single Crystal Stannic Oxide", Jack E. Houston and E. E. Kohnke, J. Appl. Phys. (in press for June, 1966).

Technical Accomplishments and Work in Progress:

Based on the results of the work to date, a decision has been reached that two main experimental areas show exceptional promise of providing better methods for probing and characterizing solid surfaces in a fashion consistent with the general research purpose of the project and with the funds and facilities available.

A. Electrical Conductance Measurements (low and medium surface-area materials).

B. Infrared Absorption of Adsorbed Gases (high surface-area materials).

To meet the experimental demands of these areas, basic items of equipment have been purchased including a liquid hydrogen cryotip for use with the infrared

spectrophotometer and a Varian Vac-Ion bakeable vacuum system for use in making measurements under "clean" ultra-high vacuum conditions. These have been received and are now in operation.

Certain specialized items of equipment have been designed and are in use. Of particular interest in connection with Area A above is the photoelectronic analysis cryostat and sample holder which was used for thermally stimulated current and optical quenching studies this past summer and is now modified to allow rapid ambient atmosphere changes and electrical measurements on specimens in flowing gas streams. A set of experiments on photocurrent decay times is in progress. Thermoluminescence has just been observed in ceramic specimens by our group and a sample holder which will allow a systematic study of this phenomenon is under construction.

The standardizing set of gas adsorption measurements has provided valuable knowledge concerning the surface area and geometry for representative forms of stannic oxide specimens. Successful preparation of stannic oxide gel has been accomplished furnishing a high surface-area form of the material which is particularly appropriate for direct gas adsorption measurements and for the infrared measurements of Area B. These results have been detailed in Interim Report SS-2 and suggestions given for modification of the B.E.T. apparatus to improve its versatility, ease of operation and sensitivity.

A self-contained beam condenser has been constructed to fit the liquid hydrogen cryotip. Measurements of the infrared absorption of hydrogen, oxygen and water vapor adsorbed on high surface-area stannic oxide gels and ceramics are being initiated in accordance with plans outlined in the recent Grant Renewal Proposal.